Indiana Department of Education
SUPPORTING STUDENT SUCCESS

MEMORANDUM

TO: Members of the State Board of Education

FROM: Stacey Hughes, Ph.D., Assistant Superintendent of Student Learning
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DATE: October 26, 2010

SUBJECT: Four-Year Math Requirement for High School and Pre-Algebra in High School

The current mathematics requirement for the Core 40 Diploma is that students receive 6 credits in mathematics and complete either math or physics in their junior or senior year. Currently, 17 states have updated their graduation requirements to include 4 years of mathematics for their standard diploma. The following represents a brief overview of the issues that are likely to affect a decision regarding the mathematics requirement for graduation:

- According to a survey of literature done by REL Midwest, current research suggests that the *type* of mathematics courses taken (e.g., the rigor of the course) is a more important factor in determining post-secondary success than the *number* of mathematics courses completed.
- The State Board has previously found that "a student who takes mathematics in the senior year is better prepared for mathematics placement exams upon entering a postsecondary education program, an apprenticeship program, or the military. A student who takes mathematics in the senior year is: (i) less likely to require remedial mathematics courses following high school; and (ii) more likely to complete a postsecondary program."
- Certain postsecondary institutions, including Purdue and IU-Bloomington, are requiring additional math courses (beyond Algebra II) for *all* incoming freshman. Others may follow suit, as they are finding that students who complete their high school course of study with Algebra II (or after their junior year) still need to take remedial math courses.

Based off of these findings, increasing the math requirement to 4 years would be advantageous to many students, but it may not help all students. It may be beneficial to continue with the current requirement for 3 years of pure math (Algebra I, Geometry, Algebra II or Integrated Math I, II, and II), but to consider a 4 year "math experience" requirement – essentially extending the "math or physics in the junior or senior year" to each year of high school but also broadening the definition to include other courses that are determined to have a significant mathematics component. Rhode Island is currently the only state of the 17 with a 4-year math requirement that allows for "math-related" courses to count as the fourth course.

During the 2008-09 school year, 38,333 students in Indiana were enrolled in Pre-Algebra at the high school level. Although some of these students were double-blocked with Algebra I, there are approximately 19,000 students in each grade (22% of students) that wait until after their freshman year to take Algebra I. As states like California push more and more students towards Algebra I in the 8th grade (over half of all 8th graders in California take Algebra I before high school), Indiana

students that wait until after their 9th grade year will typically be, at best, 2 years behind many of their peers nationally and at least 2 years behind their international peers from high-performing countries.

- Students enrolled in a college-prep curriculum demonstrate higher achievement gains than those enrolled in low-level courses—including students in the lowest performance quartiles. A study by the Center for Advanced Human Resource Studies found that students who scored in the lowest quartile in 8th grade math and took a college-prep curriculum demonstrated gains of 28 points through 12th grade, compared to students in a general track, who only showed gains of 21 points from 8th to 12th grade on average.
- Our current 4-year graduation rate is approximately 80%, which is approximately equal to the percentage of students who take Algebra I during or before their 9th grade year. Because we have not historically tracked course enrollment by student, we cannot say for certain if there is a direct link between dropping out and taking Pre-Algebra; however, based on the following research by the Gates Foundation, it is likely that this link exists.
- In a survey sponsored by the Gates Foundation, 69 percent of high school dropouts say they were not motivated or inspired to work hard and two-thirds report that they would have worked harder if more was demanded of them. In total, 70 percent were confident they could have graduated if they had tried.
- Pre-Algebra only counts as a math credit for the General Diploma, and as such it is not an appropriate course for students who are pursuing a Core 40 Diploma. An unintended consequence of allowing students to take Pre-Algebra may be that students must decide (or have decided for them) in their freshman year which track they want to be on for graduation.

Because we've moved to the Core 40 Diploma as our standard diploma, and as we move forward with the expectations of the Common Core State Standards that students are "College and Career Ready" by the end of the junior year, we need to ensure that students are on this path when they enter high school. Simply put, this path begins with Algebra I or Integrated Math I, not Pre-Algebra. The grade-level expectations of Pre-Algebra are not at a high school level, and thus we must limit the number of students who take Pre-Algebra if we are to realize our vision that the academic achievement and career preparation of *all* Indiana students will be the best in the United States and on par with the most competitive countries in the world.

The natural question that comes up, then, is this: What do we do with students who are not prepared for Algebra I when they enter the 9th grade?

- One option would be to add accountability to middle schools. Social promotion is the rule, not the exception, in most middle schools. By adding proficiency requirements to promotion, the number of students who enter high school unprepared for Algebra I would significantly drop. However, it is expected that some students would need remediation to ensure they are successful in Algebra I, even if they show a certain degree of proficiency in middle school.
- Many schools have developed courses to spread the content of Algebra I over 2 years. This model typically is ineffective, as it does not pay enough attention to remediating students on their deficient skills but simply slows down the pace of Algebra I. We would not advise schools to pursue this model.
- A second option is to provide students with a double block of math in their freshman year – one block of Algebra I, one block of remedial math. The remedial math course is closely aligned to the Algebra I course, so that students are receiving "just-in-time" remediation instead of "just-in-case" remediation, which is what typically happens in Pre-Algebra. The initial purpose of "Math Lab" was to provide schools with this opportunity, and we plan to develop a scope and sequence for a "Math Lab" course that would support this model and align to the scope and sequence of Algebra I.

In talking to teachers and studying student data, one quickly discovers that this problem is not necessarily an "Algebra" problem. The problem starts long before students enter an Algebra classroom, and research suggests that the biggest obstacle for many students in Algebra is their lack of understanding of fractions and equivalence. These concepts are introduced and developed in the elementary school curriculum, yet students are arriving to high school without a deep understanding of these important topics. As such, the plan laid out above presents a short-term solution for a larger problem: our schools are not preparing students for success at the secondary (or post-secondary) level. The following are systematic reforms that have the potential to better prepare our students for success in high school mathematics courses and beyond.

- The model of *elementary math specialists* is a common theme in math education circles across the country. Many elementary teachers do not fully understand the impact of what they are teaching on upper-level mathematics. Systems are being developed across the country to support effective math instruction at the elementary level and to deepen the mathematical content knowledge of elementary teachers. We believe that this is a conversation that Indiana should take part in.
- Earlier this year, Algebra Readiness professional development was developed for elementary school teachers, based on a former Math and Science Partnership (MSP) program. The MSP district experienced significant growth in both teacher content knowledge and student achievement. We are exploring ways to deliver this PD on a much larger scale, including online modules, to ensure that every elementary teacher in Indiana has access to this training.
- In a typical mathematics classroom, procedural fluency is the primary goal, at the expense of developing a strong foundation in mathematical reasoning and conceptual understanding. Students become proficient in low-level, rote tasks but struggle to apply the information in new ways or explain the connections between mathematical concepts (this trend shows up in both ISTEP+ and NAEP data). These are the exact skills required to be successful in higher-level math. Unfortunately, many practitioners prepare students to do well on grade-level tasks (and exams) without building other competencies that may not be tested on ISTEP+ but that are crucial for building college and career readiness. In the Common Core State Standards, these expectations are explicitly stated in the *Standards for Mathematical Practices*. Supporting teachers in the integration of these *Mathematical Practices* will help ensure that students are better prepared for success in high school math courses.
- For textbook adoption, we have updated the process to include a review of the alignment of textbooks to the *Standards of Mathematical Practices*, led by the Dana Center. As we speak with schools about the adoption process, we will emphasize the importance of choosing instructional materials that attend to the *Mathematical Practice* standards. We will recommend that districts first evaluate the materials on alignment to mathematical practices and eliminate any set of materials that does not build these competencies.
- Few, if any, high-performing countries have a high school curriculum that is as divided as the traditional Algebra I, Geometry, Algebra II sequence that is prevalent in the United States. This structure for high school courses does not lend itself well to building *Mathematical Practices*. First, applying information in new ways becomes restricted when the information is limited to only Algebra or Geometry – situations that involve such an isolated set of skills are typically contrived or highly irrelevant. Second, understanding and utilizing the connections between disciplines is important for long-term success in mathematics; quite simply, teaching Algebra, Geometry, Probability, and Statistics in isolation fails to emphasize these connections. An integrated high school curriculum allows teachers to better utilize practices that support *Mathematical Practices.*